InSight

Interior Exploration Using Seismic Investigations, Geodesy and Heat Transport

An Overview of the Entry, Descent and Landing System

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InSight - The Mission

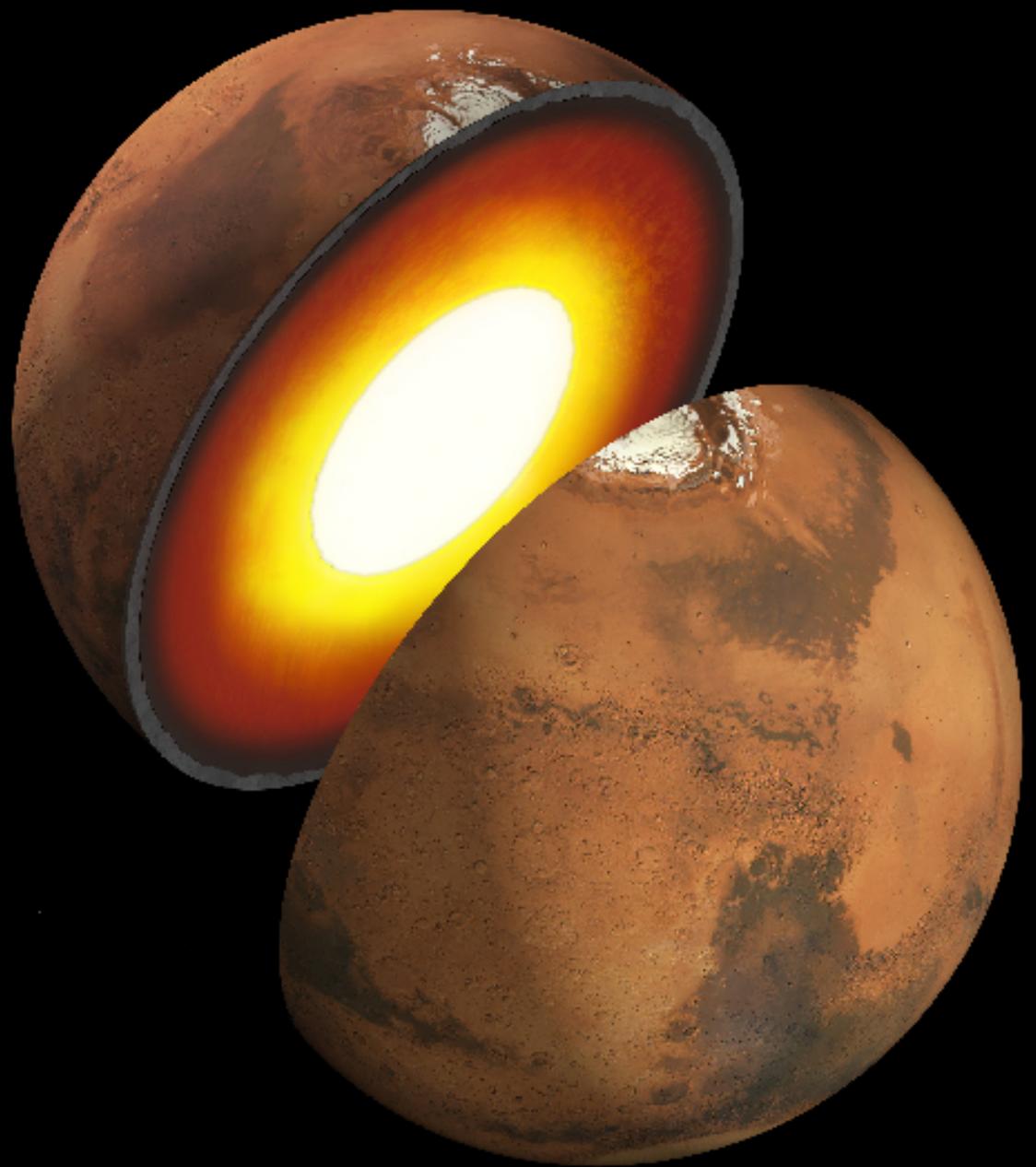
InSight Mission to Mars

InSight emerging from the California coast marine layer
May 5th, 2018

- **InSight launched on an Atlas V on May 5th, 2018**
- **First planetary mission launched from California (Vandenberg AFB)**
- **Landing on November 26th, 2018**
- **A geophysical (areo-physical) mission**
  - Investigation of the interior structure of Mars
- **The spacecraft is very closely designed after the Phoenix spacecraft that successfully landed on Mars in 2008**

https://mars.nasa.gov/insight

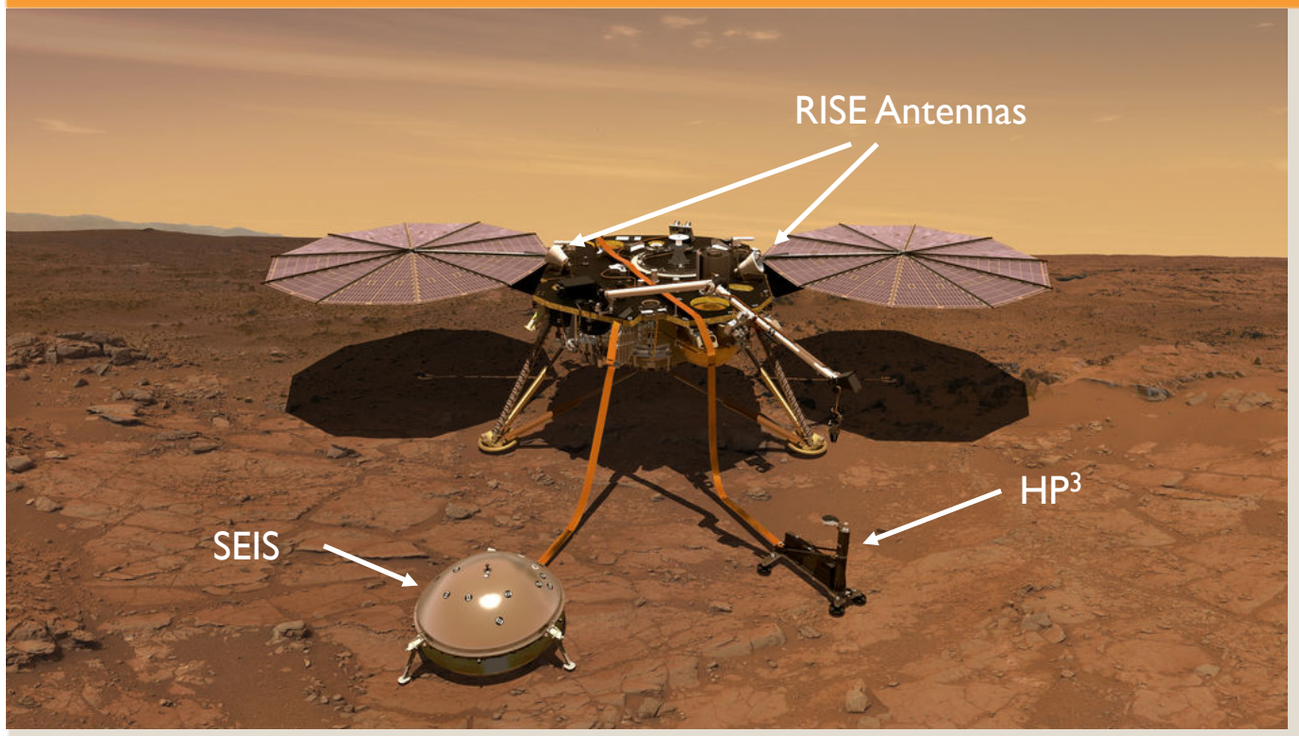
The Insight Mission Goal



- The overall goal for InSight is to understand the formation and evolution of terrestrial planets through investigation of the interior structure and processes of Mars

- This will help us understand the origin and diversity of terrestrial planets, and particularly how the evolution of terrestrial planets enables and limits the origin and evolution of life

Focused Set of Measurements



SEIS: Single-Station Seismology

- Extremely sensitive seismometer to measure Mars seismic activity
- Used to study the crust of Mars using seismic waves generated by meteor impacts, magma movement and fault movement

HP^3: Heat Flow

- Innovative, self-penetrating mole penetrates to a depth of 3–5 meters
- Measures the heat flowing out from the interior of Mars

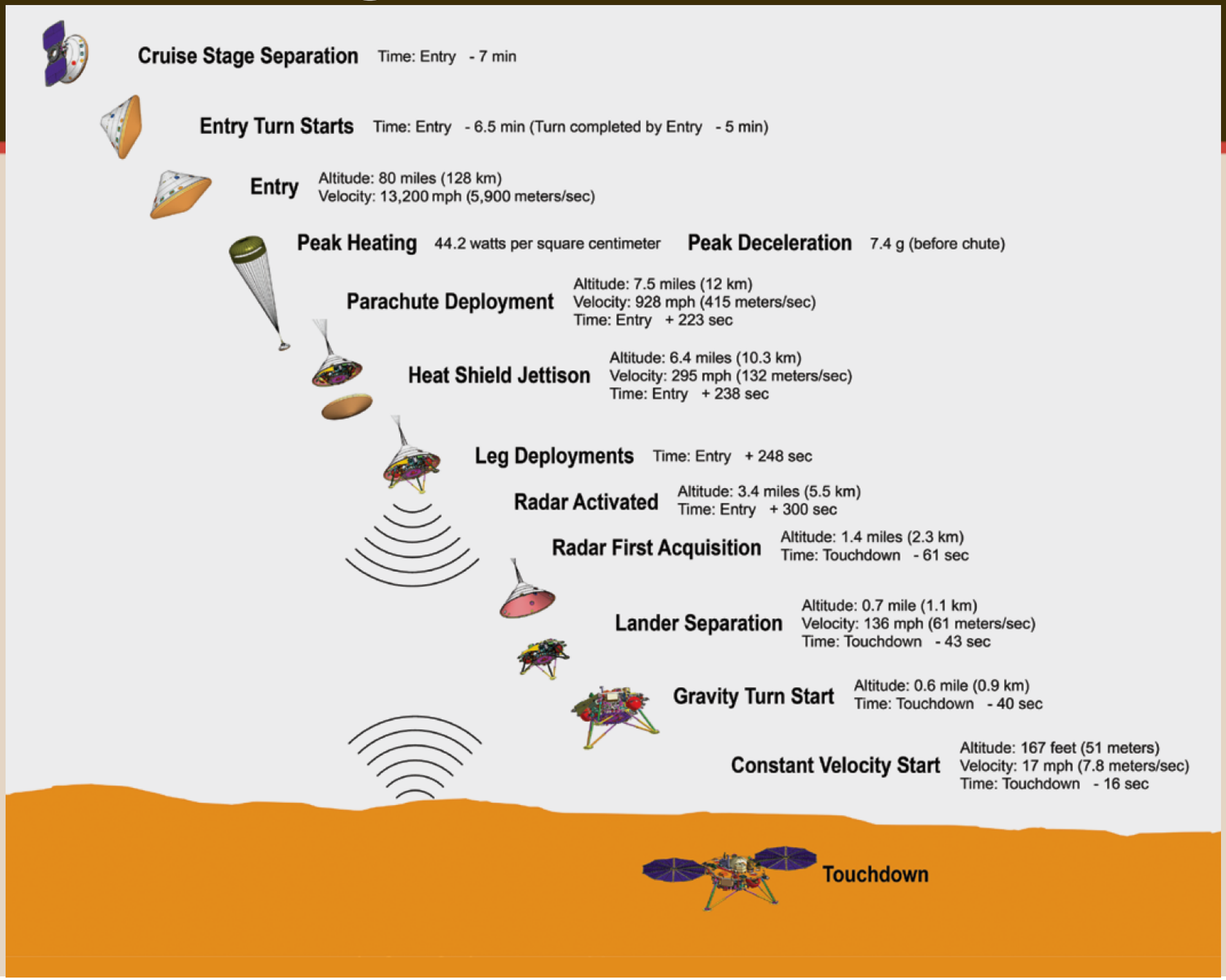
RISE: Precision Tracking

- Sub-decimeter (~2 cm) X-band tracking to precisely track the location of the lander to determine the wobble of Mars as it orbits the sun, to understand the core of Mars

InSight Being Assembled

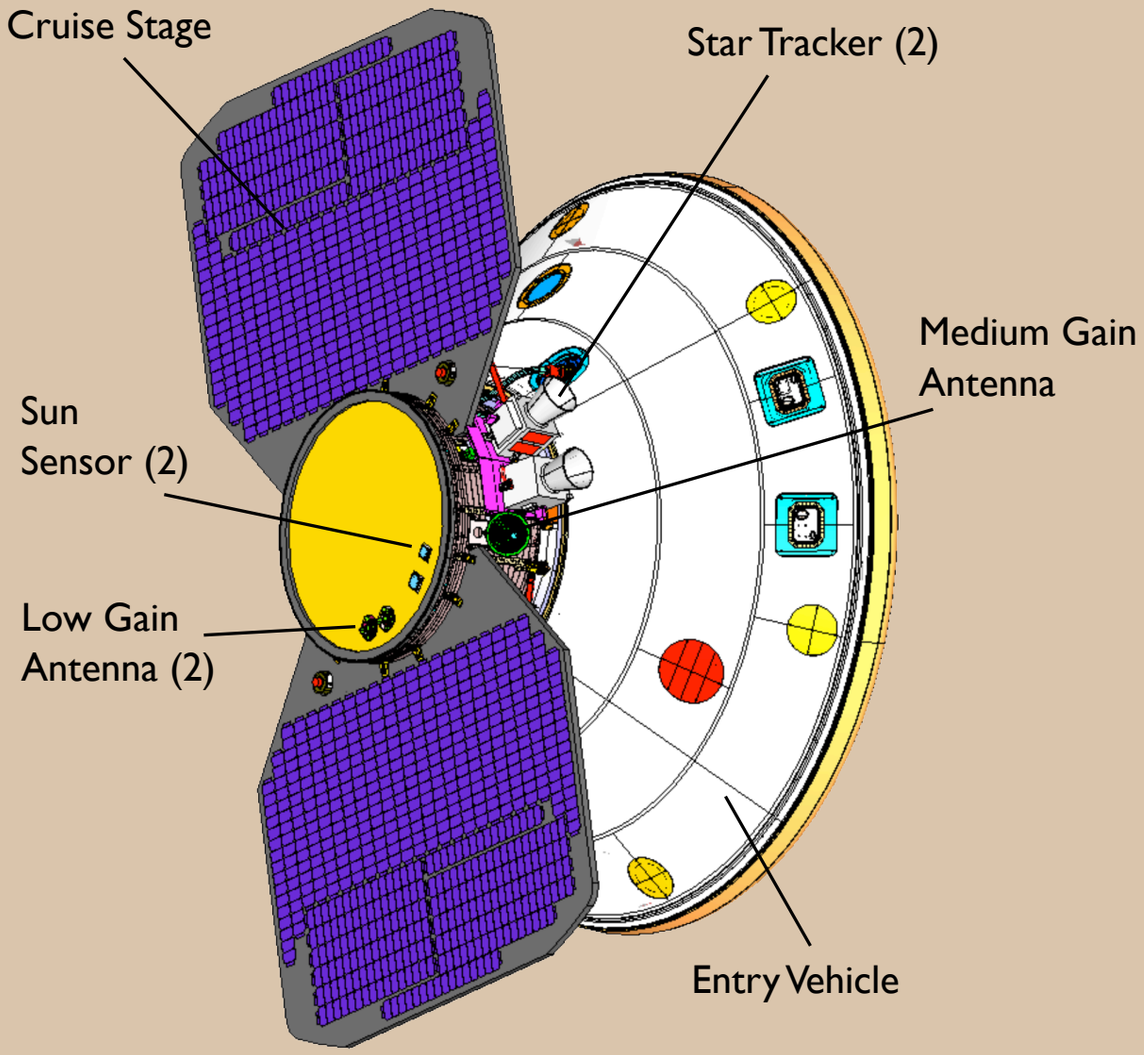
Entry, Descent and Landing (EDL)

InSight EDL Architecture



Cruise Configuration

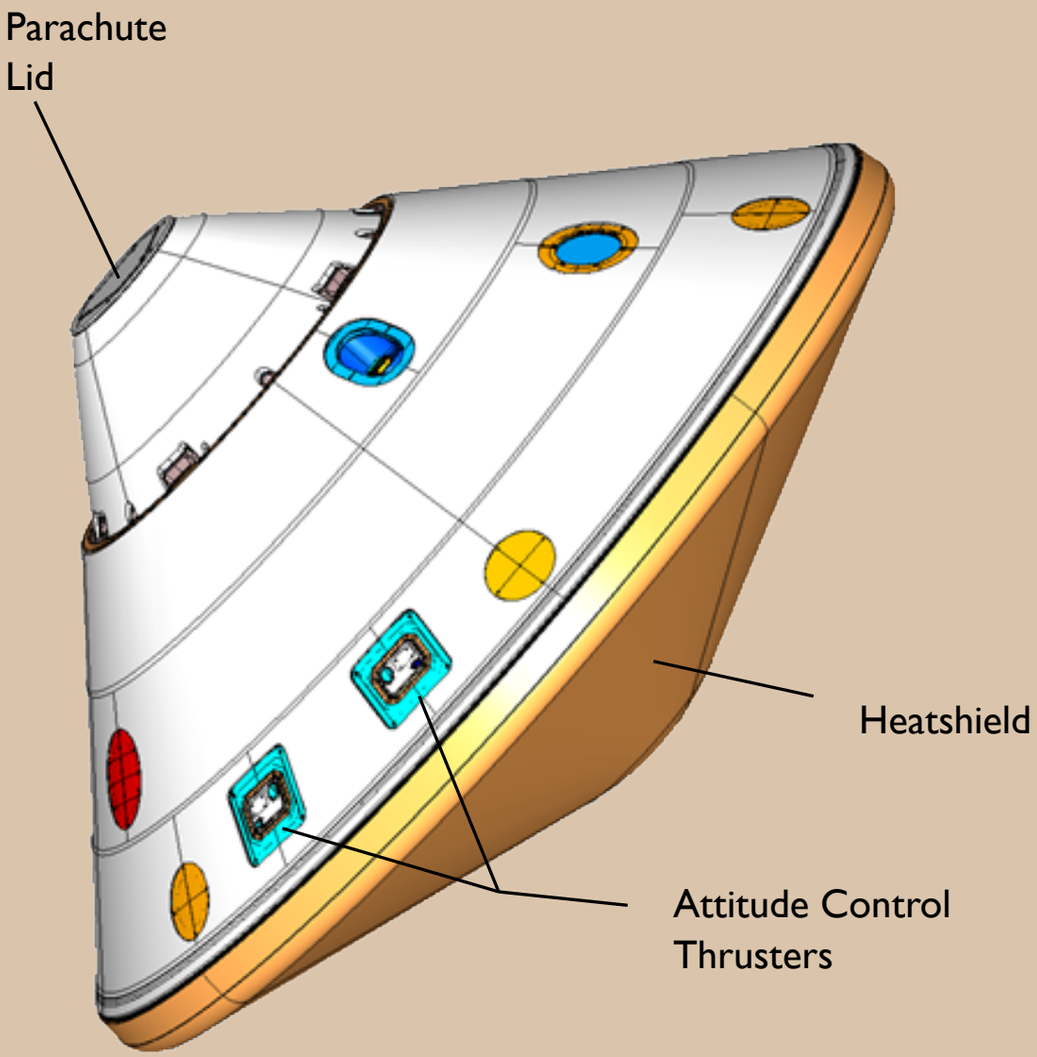
Cruise Stage solar panel design has changed since Phoenix



- Six month cruise to Mars
- Cruise Stage provides power, navigation sensors and communication
- Cruise Stage is separated seven minutes before entry
- Entry Vehicle then turns to the proper attitude for entry

Entry Configuration

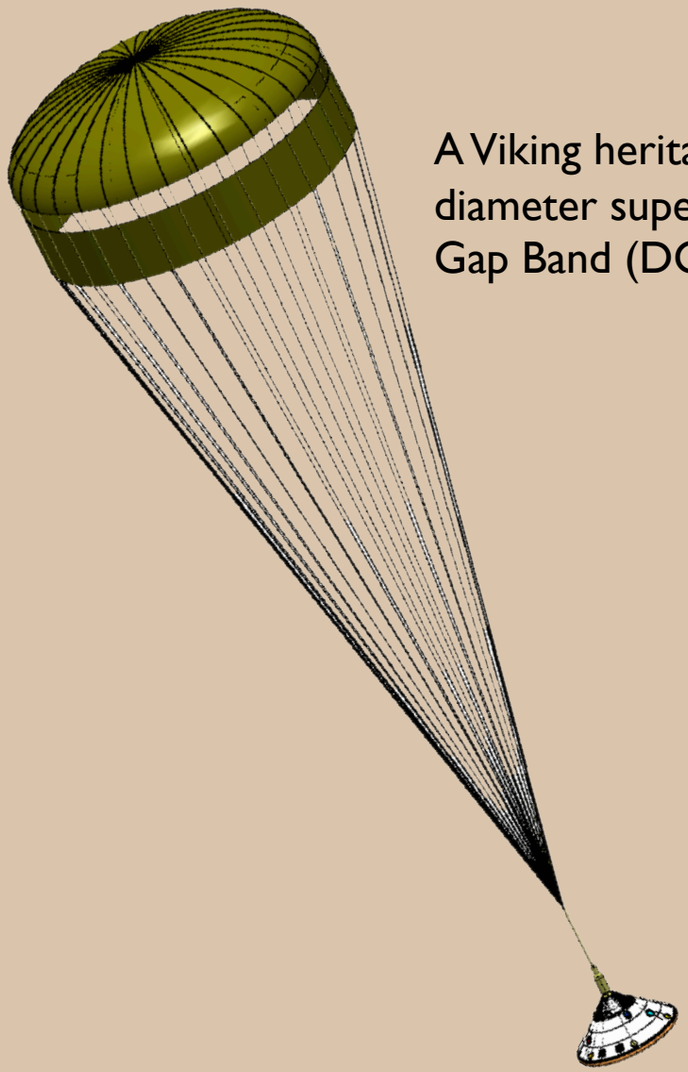
Aeroshell is very similar to Mars Pathfinder, Mars Exploration Rovers and Phoenix



- Entry Vehicle has a 2.65 m (8.7 ft) diameter heatshield with Viking heritage
- Aeroshell uses SLA thermal protection materials to protect against entry heating
- 1 lb and 5 lb thrusters provide attitude control
- Navigation is accomplished via an Inertial Measurement Unit (IMU)
  - Accelerometers and gyros

Parachute Configuration

A scaled design of the supersonic parachute flown on Viking and MSL



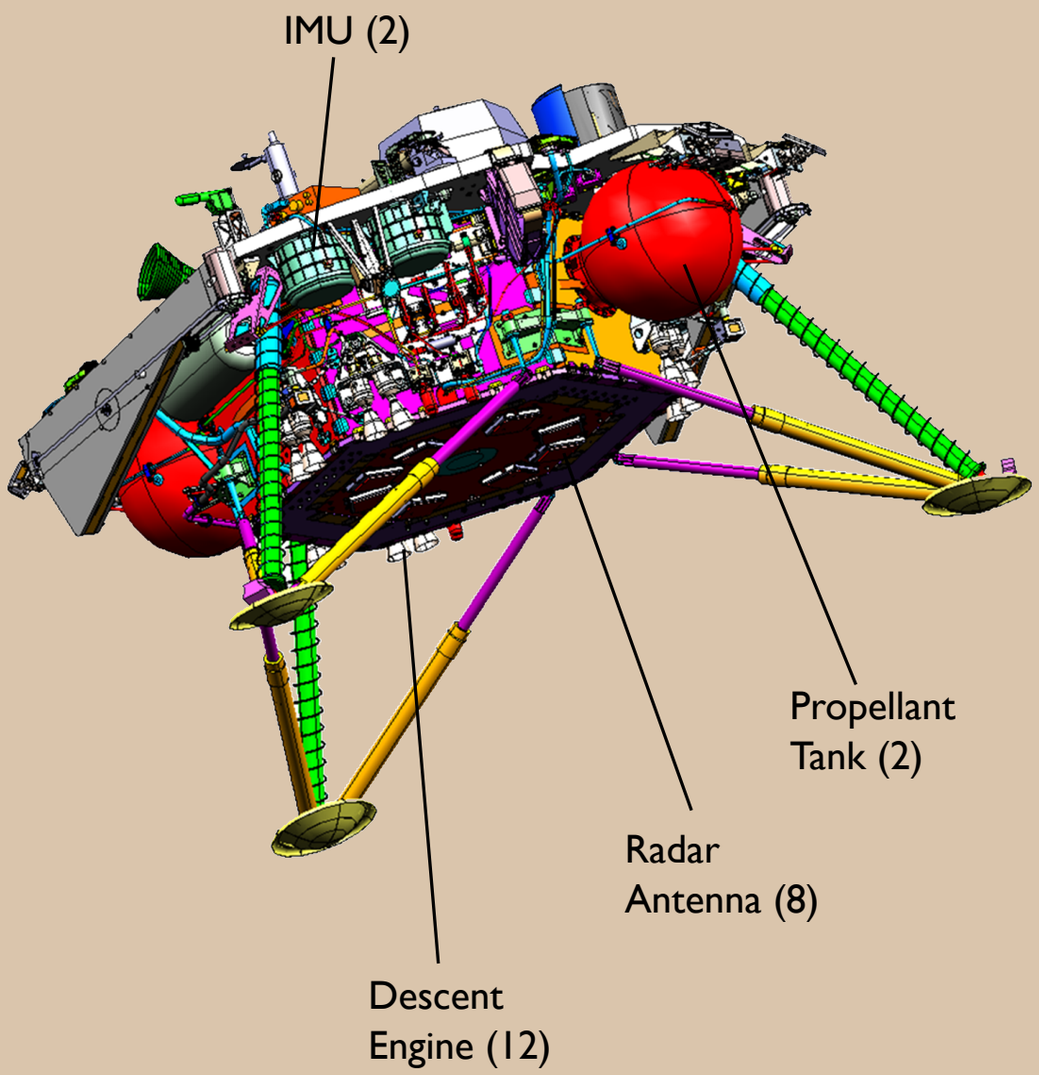
A Viking heritage 11.8 m diameter supersonic Disk Gap Band (DGB) parachute

Image of Phoenix Lander on Parachute in 2008

- Parachute is deployed at a target dynamic pressure of 525 Pa (0.08 psi)
- Spends about 140 seconds descending on parachute
- MRO will also image the InSight parachute

Lander Configuration

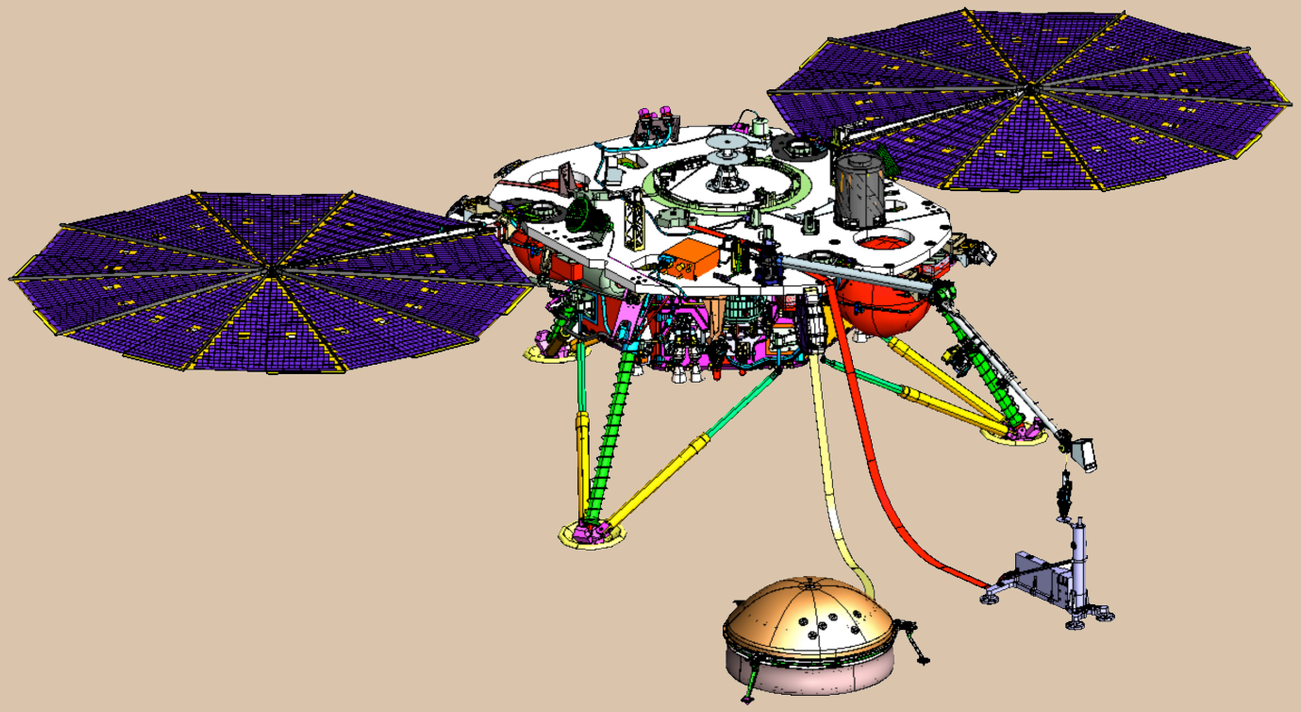
Lander design is a near copy of Phoenix and a close cousin of Mars Polar Lander



- Twelve pulse-width modulated descent engines pulsing at 10 Hz (10 times per second)
- Descent engines provide deceleration and attitude control
- Doppler radar provides altitude and velocity measurements
- Touchdown detection via sensors in legs immediately shuts down descent engines
- Target touchdown velocity is 2.4 m/s (5.4 mph)

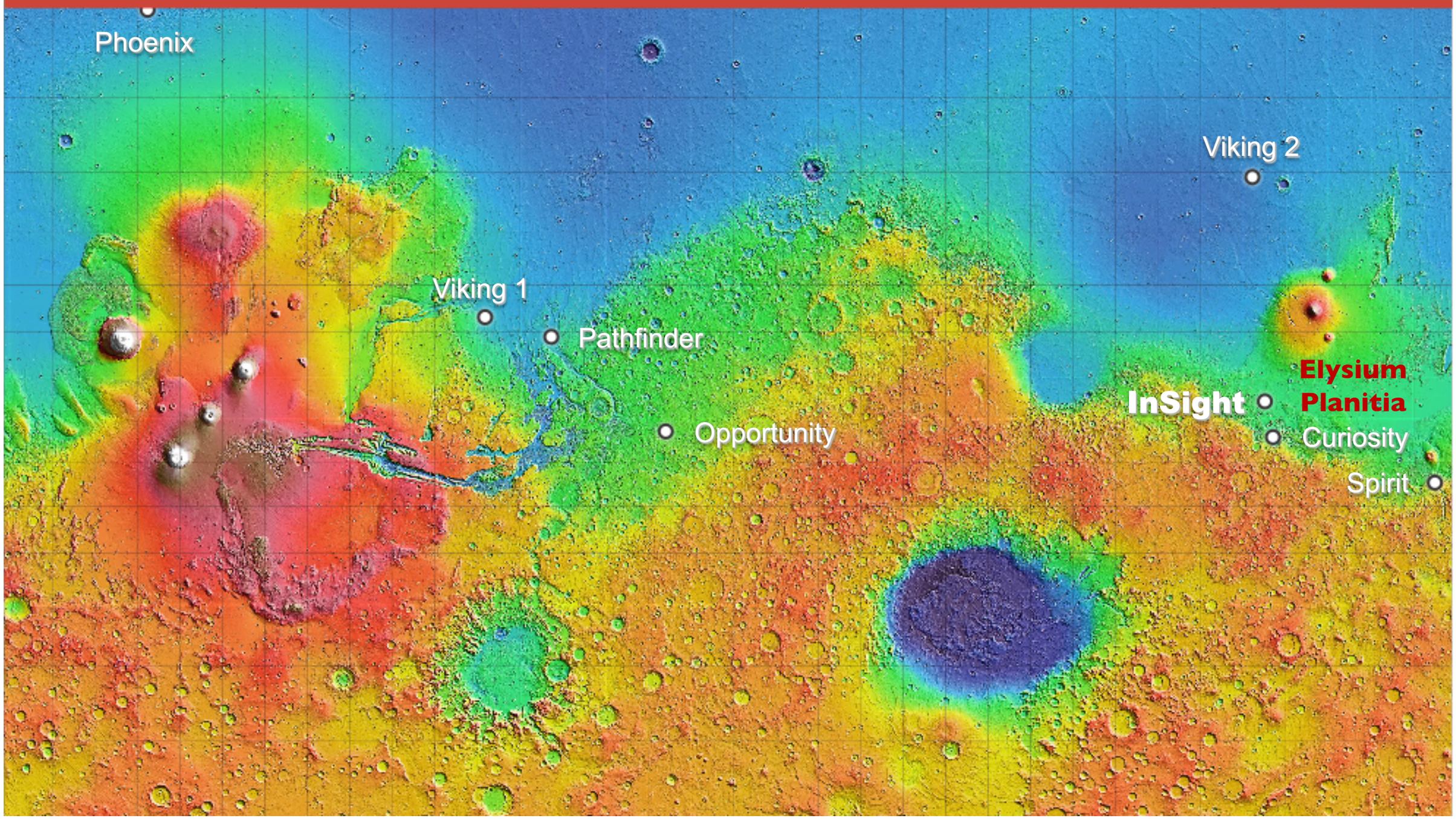
Landed Configuration

At this point in the mission the EDL system has done its job

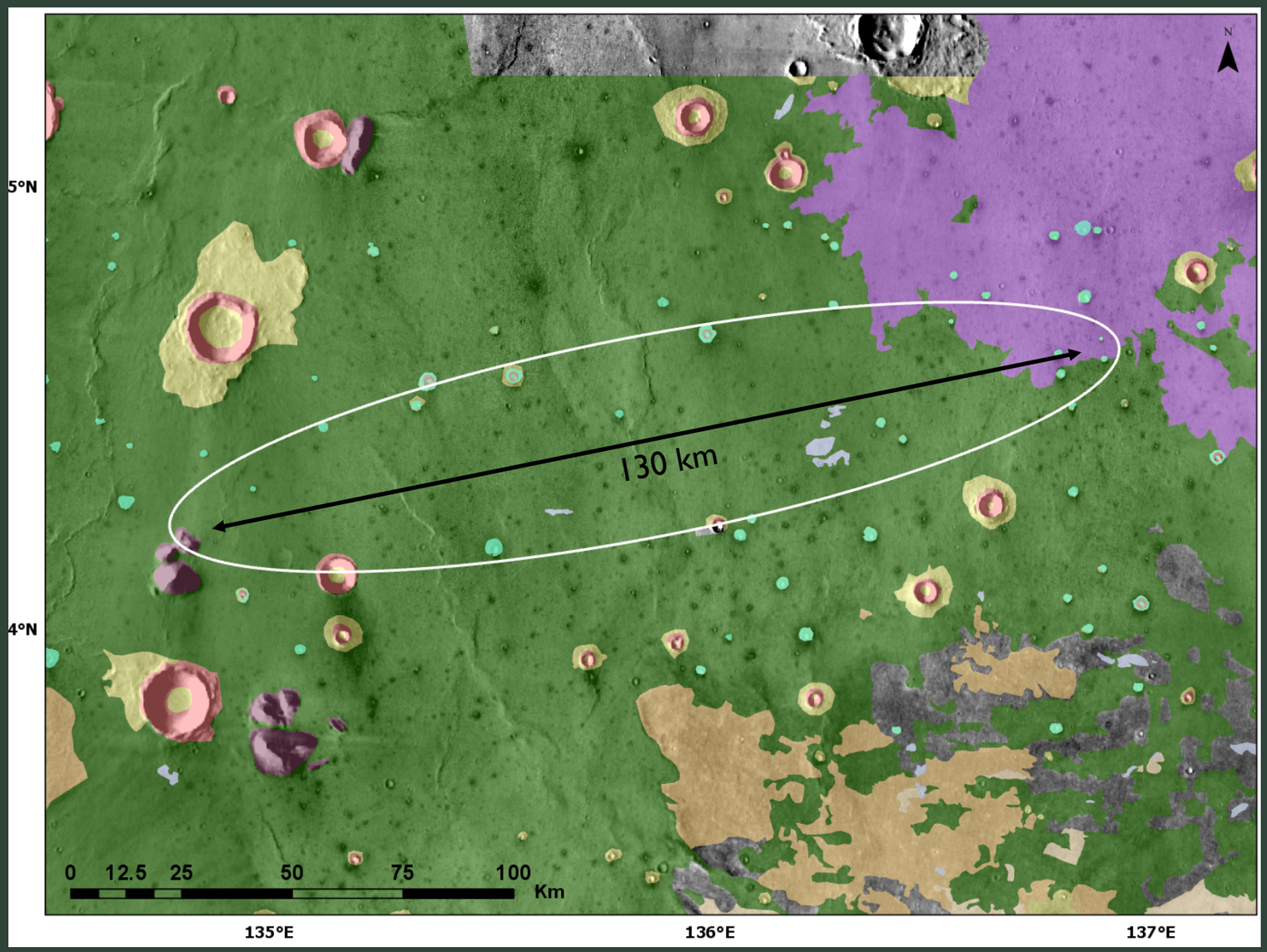


- Solar arrays are fully deployed 22 minutes after touchdown – a priority because the lander is on limited battery power during landing
- Science instruments are deployed in the days after landing

InSight Landing Area - Elysium Planitia



InSight Landing Ellipse

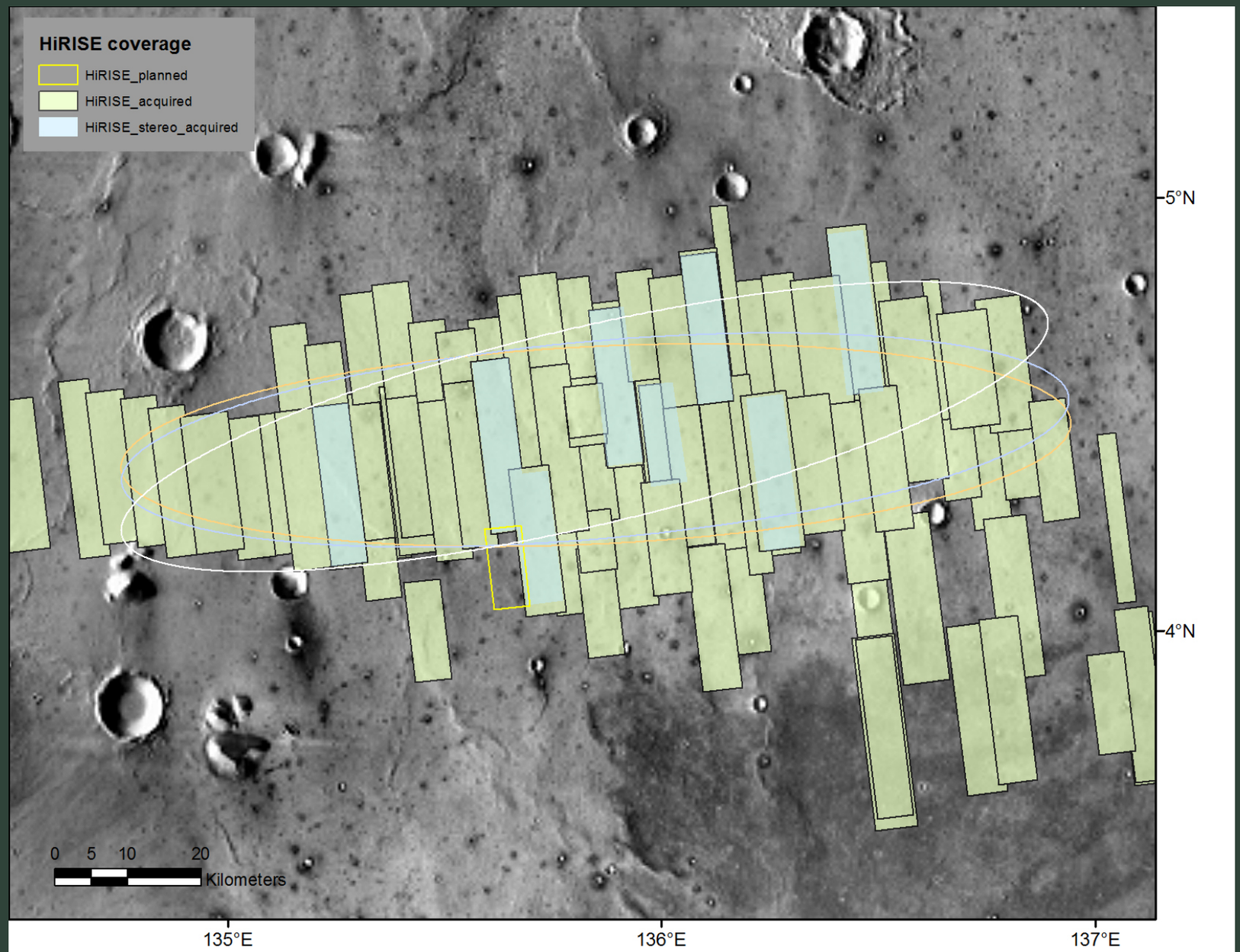


Terrain

- Smooth
- Ridged
- Crater Rim Terrain
- Ejecta
- Rocky Craters
- Etched
- Gradational Etched
- Highland Scarp
- Dense Crater Swarms

Landing Ellipse Size
130 km X 27 km
(81 miles X 17 miles)

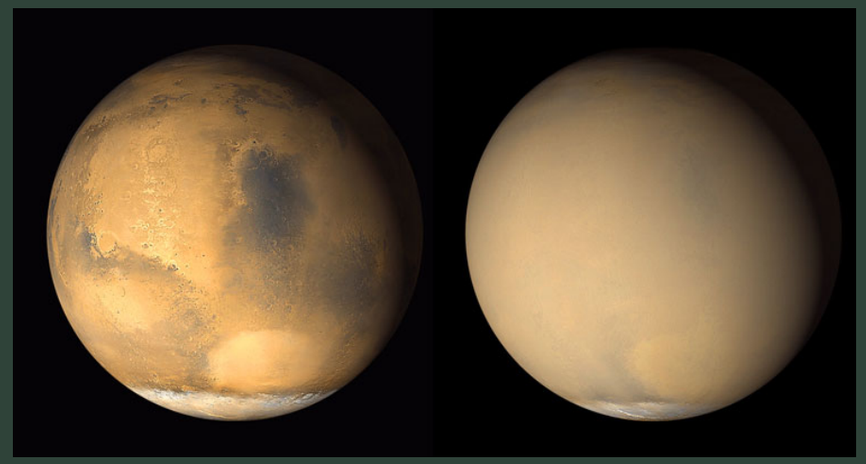
Landing Site Characterization/Safety



- Mars Reconnaissance Orbiter HiRISE instrument used to image landing site
- Can image rocks and features as small as 30 cm
- Image stereo pairs used to create digital relief maps of the landing site terrain

Landing During a Dust Storm

- A global dust storm started on Mars in late May 2018 and is currently dissipating
- Because InSight is landing during dust storm season, the landing system is designed to land under dust storm conditions
  - Heatshield has extra thickness in case flying through dust abrades away material
  - The landing radar can see through the suspended dust
  - The Landing Team will be monitoring the atmosphere prior to landing, checking to see if landing software settings need to be changed because a storm is underway
- The landing system is expected to perform successfully during a dust storm



2001 Global Dust Storm

InSight Project Team at the Jet Propulsion Lab

Landing November 26th, 2018!

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